U. S. DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN
OF THE BUREAU OF STANDARDS

ISSUED MONTHLY

Washington, February, 1930—No. 154

CONTENTS

ACCURACY OBTAINABLE WITH PIEZO OSCILLATORS

In order to secure actual data on their possibilities, as well as to develop and improve piezo oscillators for use as standards of radio frequency, the Bureau of Standards has conducted observations on a number of specially designed piezo oscillators in recent months. The circuit arrangements of all these piezo oscillators are broadly the same, being designed to minimize the effects of external influences on the frequency of operation. The construction is such that the standards are portable and of a size which could be used in a radio transmitting station.

The essential differences among the piezo oscillators were in the design of the quartz plate holder. The following summary indicates the various types of mounting:

600–1 and 200–1; circular plate, thickness vibration, horizontal position with air gap between quartz plate and top electrode, glass spacers, all surfaces plane parallel.

200–3; circular plate, thickness vibration, vertical position with air gap between quartz plate and each electrode, marble spacer, plate held in position rigidly at three points equally spaced around edge. All voltages for operating the piezo oscillator obtained from 110 volt a. c. supply.

N–5; rectangular plate, length vibration, horizontal position with air gap between quartz plate and top electrode, bakelite spacer.

100–1; rectangular plate, length vibration, horizontal position with top plate resting on quartz plate.

25–1; rectangular plate, length vibration, vertical position, electrodes sputtered on quartz plate.

The quartz plates were all kept at their working temperatures continuously except for short accidental interruptions. 100–1 and 200–3 were transported several times by truck to and from the bureau's field station at College Park, Md.; the other piezo oscillators were moved occasionally about the radio laboratory.

The following table gives the results of observation made on these piezo oscillators. Measurements were made each day during the period of observation. The maximum variation gives the worst performance and, in general, the operation was much better. Except in the two cases noted the variations were random and did not show any long-time frequency trend in either a positive or negative direction.

Oscillator No.	Period of observation	Average frequency	Maximum variation in parts per million
	Months		
600–1	8	599.913	±6
200–1	2	200.0024	±3
200–1 [1]	3½	200.0014	±8
200–3	1½	200.0013	±3
N–5 [2]	1½	199.9988	±6
N–5 [3]	1½	199.9998	±5
100–1 [4]	3½	99.9998	±15
100–1 [4]	2	100.0075	±10
25–1 [5]	3½	[5] 24.997	+23

[1] Minor change in circuit arrangement and temperature.
[2] A constant decrease in frequency.
[3] A constant decrease in frequency. Temperature changed.
[4] Change took place at time this piezo oscillator was taken from Bureau of Standards to College Park and returned. Design of plate holder such that changes would be expected when moved.
[5] Initial frequency. Change in frequency was continuous and appears to be approaching a constant value. Change indicates that sputtered electrode is dropping off the plate.

These data indicate that it is possible to construct piezo oscillators for use as frequency standards which are capable of maintaining an accuracy of greater than 1 part per 100,000 over a period of several months. This accuracy satisfies the needs of radio transmitting stations, and such standards would be adequate for station standards.

Detailed information concerning the construction of piezo oscillator 200–1 is given in a paper now in press which will appear within a few months and will be announced in these columns.

TESTING PIEZO OSCILLATORS FOR BROADCASTING STATIONS

A paper of the above title, by E. L. Hall, was published in the January issue of the Bureau of Standards Journal of Research. The devices described have played an important part in limiting interference in reception of broadcast programs. A piezo oscillator is the most suitable frequency standard thus far devised for use in radio broadcasting stations, and can be used either to measure or to control the frequency of the station. Most of the piezo oscillators tested by the bureau are for use in checking (i. e., measuring) the frequency of the station. Piezo oscillators are capable of extremely high precision in the measurement of their frequency by the use of a beat note produced by adjusting another generator to a similar frequency. This principle is employed in the methods and apparatus described in the paper.

After preliminary tests to determine the suitability of the quartz plate and its fundamental frequency, the piezo oscillator is kept in a temperature-controlled room for not less than two days, during which frequency measurements are made. The method consists in measuring the frequency of the piezo oscillator under test in terms of a standard 200-kc. temperature-controlled piezo oscillator. This is done by adjusting a radio-frequency generator to the frequency which the piezo oscillator under test should have. This adjustment is made by using harmonics from a 10-kc. generator which is kept accurately set in terms of the 200-kc. standard by observations on a special form of beat indicator. The frequency difference between the test piezo oscillator and the generator in terms of the standard is measured by comparison with an audio-frequency generator. A frequency meter of special design is used to check the frequency difference and determine the sign of the correction to be applied. The method described is also useful in the calibration of frequency meters and the measurement of station frequencies.

The method and further details are given in Bureau of Standards Research Paper No. 135, a copy of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

FOG-LANDING DEVELOPMENTS BY THE BUREAU OF STANDARDS

The bureau is serving as the research division of the aeronautics branch of the Department of Commerce. One of the developments upon which the bureau has been engaged for about a year is the use of radio to aid airplanes landing at an airport in dense fog when the ground is invisible. Numerous methods and devices are being tried, and two more years may be needed to reach a complete solution of the problem.

The pilot landing in fog must be given instantaneous information on his three coordinates in space. That is, he must be guided to and along a suitable runway, must know how far along it he has gone, and the height of the landing path above ground must be properly regulated. Of these three requirements, the first is given by a small directive radiobeacon, the second by a marker beacon, and the third by a landing beam. The first of these, the small directive beacon, has been installed by the bureau both at its own field, College Park, Md., and at Mitchel Field, L. I., for the Guggenheim Fund. At Mitchel Field successful blind landings were made by Lieut. J. H. Doolittle in September, using this beacon in conjunction with several nonradio instruments.

At College Park all three elements of the system have been installed, the small directive beacon, marker beacons, and the landing beam. The first two are identical in principle with the same devices developed for use on the airways for guiding airplanes from one airport to another; these are described in the bureau's release, "Aircraft radiobeacon development by the Bureau of Standards," and in Air Commerce Bulletin, August 15, 1929.

The method now being tried to provide the third element of the system, i. e., to regulate properly the height of the landing path as the airplane approaches the landing, is a directed beam. This beam, of 60,000 to 100,000 kilocycles, is directed at a small angle above the horizontal. A very simple receiving arrangement with visual indicator is used on the airplane. When the airplane is so maneuvered as to keep the deflection of this indicator always at a fixed point, the airplane follows a gliding path down to the ground which is quite suitable for the landing operation. In one experiment, the landing path marked out by the beam began at approximately 3 miles from the transmitter; the shape of the path can be judged from the following table:

Distance from transmitter:	Height above ground, feet
3 miles	2,000
2 miles	500
1 mile	240
½ mile	85
1,000 feet	15
750 feet	10
500 feet	5

It will be noted that the slope of this path decreases as the pilot approaches the ground; this tends to facilitate a proper landing.

Each of the three elements of the landing system is being perfected by detailed study and trial flights. Many technical problems remain to be overcome. As the elements of the system are tried in combination, some of them may be entirely altered. The work has advanced to the point, however, where the bureau is convinced that it will be possible to give instantaneous position in three dimensions to a pilot in such manner that he may successfully land in dense fog.

STRENGTH OF WELDED JOINTS IN TUBULAR MEMBERS FOR AIRCRAFT

The use of tubular members welded at the joints has become so common in aircraft construction that accurate and reliable data on the strength of welded joints are in great demand. In cooperation with the Aeronautics Branch of the Department of Commerce, the Bureau of Standards has made an investigation of the strength of welded aircraft joints. The purpose of this investigation is (1) to assist the Aeronautics Branch in its work of inspecting and licensing planes; (2) to provide fundamental data on the strength of welded aircraft joints for the benefit of the industry.

From replies to questionnaires sent to 19 leading airplane manufacturers, a test program was prepared which included determining the strength and efficiencies of some 40 welded joints in chromium-molybdenum tubing. These were of three general groups: (1) Butt joints tested in tension and compression; (2) T-joints made by welding two tubes together at angles of 90° and tested by supporting one in the testing machine while a load is applied through the other; (3) lattice joints made by welding three tubes together at angles of 60° and tested by loading the middle tube in tension, the other tubes being under compression.

Some joints were made by simply shaping the ends of intersecting tubes to fit around each other, then welding the joints. In others plates, straps, etc., were welded into the joint to determine the additional strength, if any, provided by such reinforcement.

In order that all the welding might be uniform and of good commercial quality a welding-procedure control was prepared for this investigation by the American Bureau of Welding.

The efficiencies of butt joints averaged about 88 per cent in tension and 85 per cent in compression.

It was found that inserted gusset plates and U-straps were the best methods of reinforcing T and lattice joints. Where tubes are subjected to high bending stresses it is probably more satisfactory to gain strength by increasing the size of the tube than by adding plates, straps, etc., at the joint.

In loading T-joints with the supports as close together as possible, a joint having a U-strap was about 30 per cent stronger than the unreinforced joint. The strength of the lattice joint can be increased about 20 per cent by either inserting a gusset plate in all tubes at the joint, or welding a U-strap around it.

A joint made with one gusset plate inserted through all tubes is stronger than one with several plates fitted in the angles between the tubes and welded without slotting the tubes.

The report, including drawings of each joint and graphs of the test results, has been completed and will be published soon by the National Advisory Committee for Aeronautics.

PURCHASING GASOLINE BY SPECIFICATION

In speaking before the meeting of the National Association of Purchasing Agents on January 24, Dr. H. C. Dickinson, chief of the heat and power divison of the bureau, discussed the advantages of the Government's method of buying gasoline by specification.

When a motorist drives into a filling station to replenish his gasoline supply, he is confronted with a battery of pumps containing gasolines of various brands and colors. He can exercise his choice and select a brand or color which appeals to him. If he is disappointed in the performance of the engine with this fuel, he can change to another gasoline in a few days for he has only purchased a few gallons. When the Government obtains gasoline, however, it purchases large quantities at a time, and the purchase is made under contract in which the lowest bid must generally be accepted. If an unsatisfactory fuel is obtained, many months must pass before a new supply can be procured. Hence the Government purchases according to specification in order to make sure that a good gasoline will be obtained.

In order that a gasoline may be satisfactory, it must give satisfactory engine performance. This is the real criterion for a good gasoline and is the one which is used by the Government in drawing up specifications. For the past six years the Bureau of Standards has been studying the behavior of gasolines of all sorts in engines of different kinds, in the laboratory and on the road, and has found out much about what is required of a gasoline. The development of more satisfactory test methods and the investigation of new gasoline problems are continually being undertaken, the results of which are incorporated in the specifications.

Better gasolines may be obtainable than those furnished the Government under specification, but with this system a consistently good product is obtained at a reasonable cost.

PURCHASE OF PAINT ON BASIS OF SPECIFICATIONS

At the meeting of the public-utilities group of the National Association of Purchasing Agents on the morning of January 24, P. H. Walker, chief of the paint, varnish, and bituminous materials section of the Bureau of Standards, called attention to the fact that purchasing under specification involves sampling and testing which must be paid for. In his opinion, it is unwise to use specifications except on large orders.

Specifications for paint materials when properly written contain many simple requirements and tests that can be made as well, if not better, by a competent painter than by a testing laboratory. Users of specification materials should read and understand at least all the simple requirements and tests. When, as is frequently the case, the user can by his own test assure himself that the material is not in accordance with the specification, he should reject without further test. Only when the user finds that the material meets the simple and easily determined requirements should he send the material to a laboratory for making the less simple tests. In any case, before accepting the material he should make sure it does meet all the requirements of the specification.

ACCELERATED WEATHERING OF PAINTS

The item on accelerated exposures of lithopone, lead-zinc, and white-lead paints, in Technical News Bulletin No. 152 (December, 1929), has apparently been misinterpreted. The bureau is not recommending certain kinds of white paint and discouraging the use of others. The object of the experiments is to evaluate an accelerated testing procedure. In making this comparison of the accelerated and outdoor exposure, the bureau preferred to make its own paints rather than to use any particular brands. Some paints were also desired in this series which the bureau could be reasonably sure would give good service and at least one that would not prove durable. Knowing that a white paint made of lithopone without admixture with other pigments in raw linseed-oil vehicle is not durable on outdoor exposure, this paint was selected as a paint that would not be durable and could readily be described so that it could be duplicated. The other two paints were prepared by using the same vehicle as in the lithopone paint, but selecting in one case a single pigment and in the other a mixed pigment that were reasonably sure to be more durable than the lithopone paint. The accelerated exposures have been completed. Eventually the bureau hopes to have results of outdoor exposures of the same paints. To date, however, there is practicallly no information on these outdoor exposures, and at this time it would be impossible to recommend any particular formulas, were that the object of the test, since the most important tests—outdoor exposures—are still incomplete.

CALIBRATION OF IONOMETERS FOR X-RAY STANDARDIZATION

The solution of the problems of X-ray standardization has arrived at a point where the Bureau of Standards is in a position to calibrate ionometers for the public.

The discrepancies between different standardizing laboratories in regard to the magnitude of the r-unit are now small enough to be neglected in connection with medical applications. The basis for this conclusion is the agreement within 2 per cent, recently obtained by a comparison, through the cooperation of Doctor Glasser, of two instruments from the Cleveland Clinic with those used by the Bureau of Standards; and the fair agreement found earlier between the Cleveland Clinic instruments and those of the Reichsanstalt of Germany. Further comparisons will, of course, be made between the different laboratories.

An ionometer sent to the bureau may be calibrated for any condition of voltage and filtration desired although all such instruments, to be accepted for calibration, must be adequately controlled by such means as radium or uranium oxide. This will minimize the possibility of undetected damage occurring to the ionometers in transit.

The following procedure is necessary to avoid delays and complications: Notify the Bureau of Standards as far as possible in advance of the shipment of the instrument, giving at the same time the type of instrument, date of purchase, calibrated, a copy of the calibration type of X-ray machine with which it is used, peak voltage applied to the X-ray tube as actually measured with a sphere gap, and the half-value layer in copper or the effective wave length of the radiation with an explanation of how the measurement was made.

If the ionometer has been previously calibrated, a copy of the calibration should be supplied in order to complete the bureau's records for every instrument it handles.

The cost of this service will depend upon the number of calibrations made for each instrument. A schedule of fees may be had upon request after sending in the information required above in addition to stating the number of calibrations desired.

NEW USES FOR BISMUTH

An important project under way in the metallurgical division of the bureau at the present time is a search for new and wider uses for bismuth. The industrial situation with respect to bismuth is a peculiar one. The potential supply of this metal far exceeds the present demands. However, this does not result in any material reduction in price; this is arbitrarily maintained at approximately the same figure which has held for a good many years, and only enough of the purified bismuth is marketed to insure that the current demands will be met. Bismuth is obtained to-day largely as a secondary product in the refining of other metals, notably copper, and large amounts of crude bismuth have accumulated of which no use whatsoever is being made. In other cases no attempt is made to recover the bismuth at all; it is allowed to escape in the stack gases from the smelter. If the present uses of bismuth could be broadened sufficiently or new uses found so as to create a greater demand for the metal, this demand could readily be met and, it is claimed, at a price very considerably below the present market price of bismuth.

This study is being carried out on the research-associate plan in cooperation with the copper-refining industry and has been under way for only a few months. Although bismuth resembles antimony, its sister metal, in many important respects, it is the opposite of ordinary metals in its properties; for example, it expands on freezing. It does not appear from the work done so far that wider uses for bismuth are to be found by substituting it for materials already in use. Utilization of some of the unique properties of the metal will undoubtedly be found to be the answer.

TENTATIVE STANDARD LABORATORY PROCEDURE FOR RUBBER TESTING

In the Rubber Age, January 25, 1930, page 429, there appears the Outline of Tentative Standard Laboratory Procedure for the Preparation and Physical Testing of Rubber Samples as a report of the physical testing committee of the rubber division, American Chemical Society. The report presents a standard procedure for all details connected with the mixing of the raw compounds, their vulcanization, and the control of all factors such as time of mixing, humidity, and temperature which might in any way affect the stress-strain relation of the final product.

This report embodies the results of research work carried on at the Bureau of Standards in cooperation with the physical testing committee since January, 1927, and it is expected will do much toward obtaining more uniformity in general laboratory procedure in the industry.

STANDARDIZATION OF PAPER-FOLDING TEST

The bureau has given considerable attention to the care and calibration of the Schopper type of folding tester owing to its extensive use in measuring the durability of paper. Study of this type of tester has shown that poor alignment of the rollers between which the paper is folded, excessive friction in these rollers, or variations in the springs which keep the specimen under tension during the test, may all cause serious error in the folding results.

A bureau publication (Technologic Paper No. 357, Calibration and Adjustment of the Schopper Folding Tester, by F. T. Carson and L. W. Snyder) issued in 1927, described a bell-crank lever device for adjusting the spring tension of the tester. A recent publication (Circular No. 379, Care and Adjustment of Folding Testers of the Schopper Type, by F. T. Carson and F. V. Worthington) describes an improved form of this device which is also adapted to the measurement of the roller friction. This method of measuring roller friction is described and a number of additional suggestions are made concerning the care and adjustment of the folding tester. A complete procedure for the periodic inspection and adjustment of the tester is suggested in this publication.

It is believed that these two publications will assist users of this testing instrument in standardizing and simplifying their testing procedure, and in obtaining more accurate test results.

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price of Technologic Paper No. 357 is 10 cents and of Circular No. 379, 5 cents.

RAILROAD TRACK SCALE TESTING DURING FISCAL YEAR 1929

Letter Circular No. 276, which is now available, contains a detailed report of the bureau's railroad track scale testing service during the fiscal year ended June 30, 1929. The contents of this letter circular are as follows: Introduction; track-scale tests, tabulation of test results, and discussion of test results for 1929; magnitude of weighing errors, and tabulation of these errors for 1929; track scales in grain-weighing service; master-scale tests, 1929; test-car calibrations in the field; Bureau of Standards master-scale depot; publications; cooperation with other organizations; recapitulation, results of 10,000 tests; table of average weighing errors, table showing percentage of correct scales, and table of average observed errors, all based on 10,000 tests; graphic representation of percentage of correct scales; graphic representation of average observed error, 10,000 tests; conclusions and general discussion of freight-car weighing; new specifications for industrial-service track scales; general facts relating to track-scale requirements; and a discussion of possible future requirements.

A supplement contains a description of the bureau's test equipment and methods and proposed specifications for industrial-service track scales.

A grand total of 726 track scales were tested during the year and of these 71.8 per cent were within the bureau's tolerance of two-tenths of 1 per cent of the applied load. The corresponding figures for the previous year were 703 and 70.0 per cent, respectively. The proportion of scales found to be correct in the eastern, southern, and western districts were, respectively, 68.2, 65.4, and 75.1 per cent. In the same order, the average error values were 0.22, 0.20, and 0.20 per cent of the applied test loads. The comparative standing of the three districts with respect to the average correctness of their track scales is believed to be fairly represented by these values.

Track scale grain weighing equipment at elevators and mills is still in an unsatisfactory condition, since of 97 scales tested 43 or 44.3 per cent were incorrect. Much of this equipment is of obsolete construction and incapable of meeting the exacting requirements of this service. However, it is pointed out that "at the primary terminal markets, where the greater volume of the annual grain movement is received, modern weighing equipment and competent testing and maintenance service are the rule."

The graphical analyses will be found of special interest and represent a most careful recapitulation of 15 years' work. The short discussion of probable future requirements and proposed specification for the performance of industrial service track scales will be found of great value to scale manufacturers, shippers, and the railroads.

Copies of this letter circular may be obtained from the Bureau of Standards on request.

CEMENT REFERENCE LABORATORY

Representatives of the Cement Reference Laboratory referred to in the June and October, 1929, issues of the Technical News Bulletin have visited 54 cement-testing laboratories, wherein they made the usual tests of apparatus and comparisons of methods. These inspections required the testing of approximately 3,000 pieces of apparatus. These laboratories were chiefly located in the New England and Eastern States. By

the end of January, 1930, about 13 additional laboratories will have been visited by the inspectors, who are now operating in territories not previously visited—the Southern and Southwestern States. Requests for inspections of laboratories in these sections should be made immediately if an early visit is desired.

Particular interest is attached to the demonstrations of methods by the laboratory visited and by the inspector. The comparisons thus secured serve to bring attention to numerous details of no slight importance in cement testing, which details might not so readily obtain consideration in less direct means of study. The laboratory believes that numerous variations in methods have been eliminated through this portion of the work.

The comparisons of methods have raised many questions and suggestions dealing with specifications and methods, and these questions will be discussed in a study now being made of the data accumulated by the inspectors. The tests of apparatus, supplemented by suggestions from various laboratories, and the experience of the Cement Reference Laboratory when arranging for the field-testing equipment, have provided many suggestions of value in planning a paper on the use and testing of the equipment employed in the cement-testing laboratories.

Copies of the "Proposed Tolerances on Apparatus," which form the basis of the inspections of equipment, have been distributed to each of the laboratories which have requested inspection, with the idea of promoting uniformity even before the visit of an inspector, and there is reason to believe that numerous benefits already have been secured. Copies of these tolerances will be sent to interested persons, without cost, upon request to the Cement Reference Laboratory, Bureau of Standards, Washington, D. C.

TESTS OF THE ARLINGTON MEMORIAL BRIDGE

Tests are being made by the Arlington Memorial Bridge Commission and the Bureau of Standards on one of the arch spans of the Arlington Memorial Bridge across the Potomac River at Washington, D. C.

The purpose of the tests is to obtain data on the structural behavior of the arch during and after its construction. Arch No. 7, the one selected for testing, is the second arch to the west of the bascule draw span and is one of eight similar concrete barrel arches which with the draw span constitute the main portion of the bridge structure. Arch No. 7 was designed as a symmetrical, fixed end, reinforced concrete arch having a clear span of 177 feet, 4 inches, a rise of 27 feet, 9 inches, and a barrel width of 94 feet between the outside of granite voussoir block facings.

The instruments used in the tests include copper-constantan thermocouples and resistance thermometers for measuring the concrete temperatures at various points. The thermocouples are connected to a multiple point potentiometer recorder. The rotations and deflections of the back of the arch barrel are measured by means of clinometers on a continuous line of clinometer stations extending over the extrados and a portion of each supporting pier. Readings are also made on several lines of clinometer stations situated transversely on the extrados. The strains in the extrados of the arch are measured by means of strain gages on 10 groups of strain-gage stations. The concrete strains near the intrados are measured by means of electric telemeters, one of which is located radially beneath each group of strain-gage stations.

The temperature of the concrete in the thicker portions of the arch barrel reached a maximum of 140°F. within a period of 24 to 36 hours after being placed.

Under the assumption of no relative change in pier elevation between the tests, it was found possible to measure the crown deflection with a probable error of two-thirds of 1 per cent. The clinometer accuracy was found to be sufficient to obtain significant deflection measurements corresponding to a uniform temperature change as low as two-thirds of 1° F.

The extrados bending strain was measured separately at selected points by both the clinometer and the strain gage and telemeter.

HEAVY CLAY INVESTIGATION

Mineralogical examination of 27 Ohio heavy clays shows that they are very impure, being composed of a large variety of minerals. Of the three groups, shales, glacial, and alluvial clays, represented in this study, there are certain characteristics which are common to those clays in the same group by which it is possible to make a general summary.

The average composition of the 12 shales is; sand 27, silt 41, and clay 32 per cent. The greatest variety of grain sizes are found in the sand separates, the size of grain usually being uniform in the silt and clay separates. The shales are fine grained, relatively few large grains in the sand separate being present. The average maximum diameter of these is 0.18 mm.

The common minerals are quartz mica (muscovite and sericite) clay aggregates, and iron oxide, with smaller amounts of calcite, siderite, pyrite, prochlorite, and viotite, and traces of zircon, tourmaline, and rutile. Inclusions are plentiful, rendering most of the mineral fragments very heterogeneous and many almost opaque. Usually the surfaces of the grains are either iron stained or heavily coated with iron oxide, and frequently this material acts as a cement, holding tiny mineral fragments together to form coarse aggregates. These aggregates are not broken up by the prolonged-washing process used to separate the samples into the sand, silt, and clay fractions.

The eight alluvial clays show an average of sand 19, silt 44, and clay 37 per cent. The mean diameter of the coarsest grains in the sand is 0.34 mm., a much larger number of coarse grains being present than in the shales. In addition to the minerals listed above under shales, there are small amounts of feldspar and dolomite, with traces of magnetite, garnet, and fluorite, found in the alluvial clays.

The greatest amount of variation both as to grain size and kinds of minerals is found in the glacial clays. Their average composition is; sand 22, silt 53, and clay 25 per cent. The sand separate contains the coarsest grains and more of them than the other types of clay, the average maximum diameter being 0.44 mm. The largest percentage of silt and the least of clay is to be found in glacial clays. The fresh mineral fragments have the least amount of inclusions, being clear with sharp angular outlines. The minerals, such as hornblende, feldspar, garnet, zircon, and siderite, which occur either in small amounts or traces in the shales and alluvial clays, are much more abundant and their grain size larger in the glacial clays than in the other types.

GAUGING THE SEVERITY OF BUILDING FIRES

The following is an abstract of a paper presented by S. H. Ingberg, chief of the bureau's fire resistance section, before the Sand-Lime Brick Association in New York on February 5, 1930.

The impression created by conflagrations, hurricanes, tornadoes, floods, and similar catastrophies is one of overwhelming and devastating forces against which human effort can have but little effect. However, careful examination of the ruins left by these disasters gives considerable information on their severity. Then, by applying materials, constructions, and devices of a known degree of effectiveness against the forces in question, structures can be designed to withstand these forces, and thus yield protection to occupants or to neighboring structures. In the case of fires the ruins, while giving some information (from fused metals and similar fire effects) on the temperatures obtaining in the fire, give little or no information on the length of time these temperatures prevailed.

The destructiveness of a fire is generally more dependent on duration than on the temperature. This has been demonstrated by furnace tests in which walls, partitions, fire windows and doors, columns, insulated safes, etc., are subjected to a test fire, the intensity of which is controlled so that certain temperatures within the furnace will be reached at given times after the start of the test. The fire resistance of bearing walls and floors is gauged by the time during which, exposed to the test fire on one side, they will support load and prevent ignition of combustible materials on the unexposed side; of columns, by the time, as exposed to fire on all sides, they support loads comparable with what they would carry in a building; and of safes by the time they preserve legibility of contents.

A considerable amount of information has been developed by means of such tests. Unfortunately, it has not been possible to use it to best advantage because of uncertainty as to how the intensity and duration developed in these furnace tests will compare with the intensity and duration of a fire in a proposed building containing a given amount of combustible contents. The Bureau of Standards has conducted burning-out tests in fire-resistive buildings in which furniture and contents are arranged to represent typical office and record storage occupancies. By measurement of temperatures within the buildings from the start of the fire until the ruins cool down, a measure of the severity of the fire in terms of a given duration of the above-described furnace test is obtained. From the results of these tests it will be possible, knowing the general character and amount of combustible materials that will be contained within a proposed building, to form an estimate of the maximum severity of the fire that can arise, and to choose materials and constructions of design, size, or thickness that will provide the needed protection.

A test is also described that was conducted to obtain information on the severity of fires in buildings of nonfire resistive interior constructon that collapses during the progress of the fire. Such fires furnish information on the

exposure hazard to adjacent or neighboring construction, and the effects on party and fire walls, and on record containers such as safes and vaults located within the building and subjected to impacts when floors and walls collapse and to a prolonged heat exposure if buried in the hot ruins.

GROWTH IN CITY PLANNING

A survey recently completed by the bureau shows a growing interest in city planning in all parts of the United States. A tabulation made from returns to questionnaires sent to various cities, towns, and villages shows that at least 691 of these municipalities have official planning boards or commissions in existence. Of this number, 208 are cities having a population of over 25,000. The other 483 vary in size down to villages of less than 1,000, and several of the smallest of these have less than 500 inhabitants.

Cities having planning commissions are believed to be more apt than others to exercise foresight and true economy in controlling the laying out and improvement of streets, the location of transportation facilities, in making provision for street traffic, and in the regulation of private use of land through zoning ordinances.

The tabulation, in addition to summarizing the total number of planning commissions now in existence, groups them according to States, and presents data as to the number of members composing each commission, the number of appointed members, and the number of ex-officio members, the terms of office and the title of the executive officer, and indicates which cities have zoning ordinances in effect.

CONSTRUCTION ACTIVITY DURING NOVEMBER, 1929

The value of construction contracts awarded in 37 Eastern States during November, 1929, as reported by the F. W. Dodge Corporation, was $391,012,500, which was 17 per cent less than in November, 1928, and lower than in 1927 and 1926 by 16 and 20 per cent, respectively. Commercial buildings showed an increase of 49 per cent over the same month last year, and awards for industrial construction, public buildings and hospitals and institutions were also greater. Residential building was 43 per cent and public works and utilities construction 22 per cent less than during November a year ago.

The cumulative value of contracts awarded during the first 11 months of the year was $5,455,192,400, a decline of 12 per cent in comparison with $6,203,429,800 in 1928, but only about 6½ per cent less than in 1927 and 1926. Of the principal classes of construction, commercial building was 10 per cent greater than last year and industrial construction 15 per cent greater, and of the less important groups, public buildings increased 70 per cent. Residential building was 31 per cent behind last year at the end of November and public works and utilities 5 per cent less than a year ago.

NEW AND REVISED PUBLICATIONS ISSUED DURING JANUARY, 1930

Journal of Research [1]

Bureau of Standards Journal of Research, Volume 2 (RP Nos. 37 to 76), bound in cloth, $2.75 (foreign, $3.50).

Bureau of Standards Journal of Research, Vol. 4, No. 1, January, 1930 (RP Nos. 129 to 139, inclusive). Obtainable only by subscription. (See footnote.)

Research Papers [1]

(Reprints from Journal of Research)

RP120. Turning with shallow cuts at high speeds; H. J. French and T. G. Digges. Price, 30 cents.

RP121. Further experimental production of currency paper in the Bureau of Standards paper mill; M. B. Shaw and G. W. Bicking. Price, 15 cents.

RP122. A method of measuring the stress-strain relations of wet textiles with application to wet rayons; H. A. Hamm and R. E. Stevens. Price, 10 cents.

RP123. Corrosion of open-valley flashings; K. H. Beij. Price, 10 cents.

RP124. Comparative properties of wrought iron made by hand puddling and by the Aston process; H. S. Rawdon and O. A. Knight. Price, 30 cents.

RP125. A gravimetric method for the determination of ruthenium; R. Gilchrist. Price, 5 cents.

RP126. Observations on the iron-nitrogen system; S. Epstein, H. C. Cross, E. C. Groesbeck, and I. J. Wymore. Price, 20 cents.

RP127. Melting, mechanical working, and some physical properties of rhodium; W. H. Swanger. Price, 10 cents.

[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama; other countries, 40 cents). Subscription to Journal of Research, $2.75; other countries, $3.50. Subscription to Commercial Standards Monthly, $1; other countries, $1.25.

RP128. Optical rotation and ring structure in the sugar group. The optical rotation of the various asymmetric carbon atoms in the hexose and pentose sugars; H. S. Isbell. Price, 5 cents.

Circulars [1]

C378. Alphabetical index and numerical list of Federal Specifications promulgated by the Federal Specifications Board (complete to November 1, 1929). Supersedes C371. Free on request to Bureau of Standards.

C379. Care and adjustment of folding testers of the Schopper type. Price, 5 cents.

Simplified Practice Recommendations [1]

SPR1–29. (7th ed.) Vitrified paving brick. Price, 10 cents.

SPR16–29. (4th ed.) Lumber. Price, 30 cents.

SPR45–28. 3d ed.) Grinding wheels. Price, 15 cents.

SPR87–29. Sizes of removable and permanent forms, pans, or domes made of wood, steel, or other material used in concrete-ribbed floor construction. Price, 5 cents.

SPR99–30. Pocketknives. Price, 10 cents. cents.

Miscellaneous Publications [1]

M101. Report of the 22d National Conference on Weights and Measures attended by representatives from various States, held at the Bureau of Standards, Washington, D. C., June 4, 5, 6, and 7, 1929. Price, 30 cents.

Commercial Standards Monthly [1]

CSM. Vol. 6, No. 7, January, 1930. Obtainable only by subscription. (See footnote.)

Technical News Bulletin [1]

TNB154. Technical News Bulletin, February, 1930. Obtainable only by subscription. (See footnote.)

[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama; other countries, 40 cents). Subscription to Journal of Research, $2.75; other countries, $3.50. Subscription to Commercial Standards Monthly, $1; other countries, $1.25.

OUTSIDE PUBLICATIONS [2]

In this list are included, in so far as possible, all articles by members of the bureau's staff on scientific and technical subjects. Some of these articles are written in the author's unofficial capacity only, and deal with subjects outside the field of the Bureau of Standards. The article itself should always be consulted to determine whether or not it expresses the official opinion of the bureau.

Gas-filled lamps as photometric standards. R. P. Teele; Transactions, Illuminating Engineering Society (New York, N. Y.), Vol. 25, p. 78; January, 1930.

Long-wave radio receiving measurements at the Bureau of Standards in 1928. L. W. Austin; Proceedings, Institute of Radio Engineers (New York, N. Y.), Vol. 18, p. 101; January, 1930.

The grounding of electrical circuits and equipment. M. G. Lloyd; Proceedings, Fourth Annual Meeting, International Association of Electrical Inspectors (Chicago, Ill.), p. 45; September, 1929.

Eyesight is priceless. M. G. Lloyd; Safety Education (National Safety Council, New York, N. Y.), p. 146; February, 1930.

Determining compressibility of a gas. H. S. Bean; The Oil and Gas Journal (Tulsa, Okla.), Vol. 28, No. 35, p. 42; January 16, 1930.

Thermal expansion of "carbaloy." Peter Hidnert; Physical Review (Corning, N. Y.), Vol. 35, p. 120; January 1, 1930.

Testing building material to determine resistance to fire. S. H. Ingberg; United States Daily (Washington, D. C.), Vol. IV, No. 262, p. 16; January 9, 1930.

Fire loss decreased by increased use of resistive material. S. H. Ingberg; United States Daily (Washington, D. C.), Vol. IV, No. 265, p. 10; January 13, 1930.

Relations between rotatory power and structure in the sugar group:

Part 21. Beta-thiophenol glycosides of glucose, xylose, and cellobiose. C. B. Purves; Journal American Chemical Society (Washington, D. C.), Vol. 51, p. 3619; 1929.

Part 22. Evidence concerning the ringed structure of beta-thiophenol cellobioside and beta-thiophenol lactoside. C. B. Purves; Journal,

[2] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

Relations between rotatory power and structure in the sugar group—Con. American Chemical Society (Washington, D. C.), Vol. 51, p. 3627; 1929.

Part 23. The preparation and the structure of beta-thiophenol maltoside and of its hepta-acetate. C. B. Purves; Journal, American Chemical Society (Washington, D. C.), Vol. 51, p. 3631; 1929.

Incoherent scattering. R. M. Langer; reprinted from Nature (London, England), March 9, 1929.

Photoionization of caesium vapor. F. L. Mohler, C. Boeckner, R. Stair, and W. W. Coblentz; reprinted from Science (New York, N. Y.), Vol. LXIX, No. 1792, p. 479; May 3, 1929.

Quantum mechanics of chemical reaction. R. M. Langer; reprinted from Physical Review (Corning, N. Y.), Vol. 34, No. 1, p. 99; July 1, 1929.

Recombination and photoionization. F. L. Mohler; Physical Review Supplement (Corning, N. Y.), Vol. 1, No. 2, p. 216; October, 1929.

Critical potentials of atoms and molecules. F. L. Mohler; reprinted from International Critical Tables (National Research Council, Washington, D. C.), Vol. VI, p. 69; 1929.

The relative intensity of X-ray satellites. F. L. Mohler and F. K. Richtmyer; Science (New York, N. Y.), Vol. LXX, No. 1025, p. 616; December 20, 1929.

Phase equilibria in the system SiO_2–ZnO. E. N. Bunting; Journal, American Ceramic Society (Columbus, Ohio), Vol. 13, No. 1, p. 5; January, 1930.

Soundproofing of airplane cabins. V. L. Chrisler; Aviation (New York, N. Y.), p. 1021; November 23, 1929.

Aircraft instruments. W. G. Brombacher; Instruments (Pittsburgh, Pa.), Vol. 3, No. 1, p. 21; January, 1930.

Tension, bend, and impact tests on reinforcement bars. W. A. Slater and G. A. Smith; Proceedings, American Socity for Testing Materials (Philadelphia, Pa.), Vol. 29, Part II, p. 183; 1929.

Outline of tentative standard laboratory procedure for the preparation and physical testing of rubber samples. Report of physical testing committee, Rubber Division, American Chemical Society; Rubber Age (New York, N. Y.), p. 429; January 25, 1930.

Blistering phenomena in the enameling of cast iron. A. I. Krynitsky and W. N. Harrison; Journal, American Ceramic Society (Columbus, Ohio), Vol. 9, p. 16; January, 1930.

Tensile properties of rail and other steels at elevated temperatures. J. R. Freeman and G. W. Quick; American Institute of Mining and Metallurgical Engineers (New York, N. Y.), Technical Publication No. 269; February, 1930.

Constitution of iron-phosphorus alloys. L. Jordan; A. S. S. T. Data Sheets, Transactions, American Society for Steel Treating (Cleveland, Ohio), Vol. 17, p. 273; January, 1930.

What constitutes a bronze? (Reprint of Letter Circular No. 268.) Iron Age (New York, N. Y.), Vol. 125, p. 236; January 16, 1930.

Properties of stone and clays studied to improve products. A. N. Finn; United States Daily (Washington, D. C.), Vol. IV, No. 263, p. 8; January 10, 1930.

Intricate machine determines strength of chinaware in service. G. W. Wray; United States Daily (Washington, D. C.), Vol. IV, No. 265, p. 5; January 13, 1930.

Calculation of compounds in Portland cement. R. H. Bogue; Portland Cement Association Fellowship (% Bureau of Standards, Washington, D. C.), Paper No. 21; October, 1929.

Many varieties of clay products turned out by Bureau of Standards. H. D. Hubbard; United States Daily (Washington, D. C.), Vol. IV, No. 279, p. 5; January 29, 1930.

The Commercial Standards Monthly and the National Bureau of Standards. S. F. Tillman; The Millers Review (Atlanta, Ga.), Vol. XCIII, No. 11, p. 24; November, 1929.

An outline of the work of the National Bureau of Standards. George D. Miller; The Elephant (St. Louis, Mo.), Vol. 9, No. 1, p. 4; January, 1930.

The workers at the Bureau of Standards and their work. George K. Burgess; the Federationist (Washington, D. C.), Vol. 37, No. 2, p. 164; February, 1930.

U. S. GOVERNMENT PRINTING OFFICE: 1930